AIR WAR COLLEGE

AIR UNIVERSITY

INFORMATION ENGINEERING

THE FOUNDATION OF INFORMATION WARFARE

by

Robert J. Wood

Lieutenant Colonel, USAF

A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

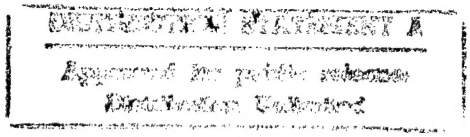
FULFILLMENT OF THE CURRICULUM

REQUIREMENT

Advisor: Colonel Richard Szafranski, USAF

MAXWELL AIR FORCE BASE, ALABAMA

April 1995



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ABSTRACT

TITLE: Information Engineering: The Foundation of Information Warfare.

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If information is governed by physical laws, information engineering may be possible. If information engineering is possible, it forms the basis for developing information weapons. Thus information engineering is the foundation of information warfare.. This paper establishes the theoretical linkage between the potentially new discipline of information engineering and the activities that could encompass information warfare.

The focus of this paper is on applying the lessons from other engineering disciplines and the body of physics and physical knowledge to the field of information warfare. The study of information engineering begins by modeling the ways in which individuals process information. Once the information engineer understands the model for individual information processing, the engineer can use the model to illuminate some of the vulnerable aspects of group and mass processing of information. Knowing the physics of information enables the information engineer to better understand and apply appropriate tools in twenty-first century information warfare.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Robert J. Wood (B.S. Electrical Engineering and M.S. Electrical Engineering, Clemson University) is a fighter pilot and test pilot who served in a variety of operational flying and flight test positions since his initial active duty assignment in 1977. His interest in information warfare and the possibility of defining the key features of information engineering as new discipline culminated while attending the Air War College in 1994 and 1995

APOLOGIA

An *apologia* is less of an apology than it is a defense. The objective of this paper is to inquire into the possibility of a new kind of engineering to produce new kinds of weapons and new warfare capabilities. The paper focuses on science and applications, not on law, ethics, or policy. Even so, I am aware that ethical issues arise from the application of *any* warfare tools or weapons. This obviously would be true should it be possible to develop information warfare tools. Sophisticated information warfare is far different from other kinds of warfare. In other kinds of warfare an objective of combatants is overt denial of observable data to the enemy. In sophisticated information warfare combatants affect adversary decisions and outcomes covertly by precisely engineered information aimed at human senses and the human brain. The ethical issues involved probably will not become compelling until some time in the future. Some time in the future, and after an interval of successful engineering, others will become aware that the capability for very sophisticated and covert information warfare exists. For the paranoid mind, it may be easy to conclude that such covert action has been, or could have been, underway for some time. How would one know if clandestine manipulations of group or individual decision processes occurred or are occurring? This leads to the critical ethical questions within information warfare. What is real *truth* and how does one know? What is real *freedom of choice* and how does one know? If any nation or group developed the capability to deny our nation the ability to know what was true or deny us our freedom of choice, we could not survive as a nation. Possession of the truth and preservation of freedom of choice are both critical and fundamental capabilities.

It is just those capabilities that must be sanctuaried if we are to protect and defend friendly forces from information attacks by an adversary's information engineers and information warriors.

We must preserve our ability to know real truth and our own freedom of choice, especially if either or both of those are engaged by an adversary. This paper discusses what appears not to be possible, but is clearly not impossible. The potential for manipulating or engineering information appears to be both shocking and unethical to some. It certainly may be both, and therefore needs to be discussed and debated by experts on the ethics of warfare tools, or weapons, and their employment. It is beyond the scope of this paper to debate those ethical issues here. This paper simply offers some understanding of the potential capabilities of the next-generation tools of warfare: information weapons for information warfare. If that causes the reader discomfort, good. That discomfort signifies that the reader's ethical sensibilities are intact and functioning. War has always been an ugly and deplorable conflict resolution method. That has not changed nor will it change with the introduction of new tools for information warfare. War, as General Sherman observed after the Civil War, is "barbarism" and "hell." Information warfare adds the barbarism and hell of mental control to the barbarism of physical destruction, injury, and death. If information engineering is possible, a new kind of warfare may be possible. What follows describes the technical and tactical characteristics of the weapons of the future. What must follow an evaluation of the technical and tactical characteristics of information weapons is an appraisal of the legitimacy, morality, and legality of information warfare as a warfare form. The possibility that truth and freedom of choice could be destroyed by new weapons and new warfare forms is frightening indeed. An awareness of just how frightening emerges as one understands the potential of information engineering. This potential can be realized by individuals, groups, or states. We have no choice but to study information engineering, if only to defend ourselves.

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INTRODUCTION

The Awakening

One of the most riveting subjects in military discussions today is information warfare. From the definitions of information warfare to the development of weapons, and everything in between, it is being discussed simultaneously by all the military services. The Department of Defense established a classified information warfare policy in April 1993. The Air Force quickly followed with its own classified policy and created an Information Warfare Center in San Antonio, Texas.[1] The rapid increase in the knowledge base on the subject is typical of new warfare ideas and concepts. What is atypical are the revolutionary implications that information warfare concepts bring to the battlefields and battlespaces of the future.

Why information? An information wealth and knowledge base that is greater than an adversary can lead to dominance over an adversary.[2] The business and economic community have demonstrated this fact across the spectrum of business enterprises from small businesses to large international corporations. The range of business activities from production and distribution operations to marketing and customer focus is dependent on information. Successful businesses do not wait for the customer. Businesses go to the customer having already acquired information about the customer and provide products matched to individual customer needs. Those businesses that lack information critical to their decision process are simply gambling that their decisions are correct. Imprecise information is uneconomical and can have costly consequences in competitive enterprises. War is the ultimate competitive enterprise. Information precision is a

form of wealth that offers to the military force a break from the classical mass force destruction characteristics of annihilation warfare typical of the twentieth century wars. The armed forces no longer have to overpower with excess materiel capacity. With the right information the armed forces can tailor the force and weapon to customer (enemy) needs and influence the outcome of the conflict.

The United States currently basks in an era of global power, recognized as having superiority in all areas, including information superiority. Evidence of the information age surrounds us visibly in our daily lives from news broadcast to "micro-marketing" and advertising to distribution and purchases of consumable products. Collectively the indications are that Western culture has acquired dominance of information and therefore power over all other state groupings. Sustaining that power by political, economic and military means is viewed as essential for national security.[3]

The Potential

In the past effective United States armed forces' power projection has been lethal and directed at adversary nation states. Very few exceptions exist. The information age offers and demands increased availability of non-lethal tools aimed at specific state and non-state threats. These two features, non-lethality and non-state aimed, are new to the nature of classical warfare and arise from the availability of more information processed into more knowledge. Non-lethal weapons are desirable and offer a moral high ground that fits with the expectation and ethos of Western culture. Recognition of the additional dangers posed by hostile *non*-nation state groups

is important because it represents a different and more realistic approach than the simplistic one of lumping these kinds of entities together and calling them all "terrorist." Sun Tzu may have captured the concept and new features of information warfare best when he stated twenty-five centuries ago that defeating the enemy without direct lethal force was preferable.[4] These two new features, non-lethality and group aimed, are the revolution that elevates warfare to a new level in information warfare.

Many have quickly supported the Tofflers' insights that information wealth will lead to information warfare. The immediate demand then is to define, characterize, and develop information warfare so as to be prepared before the future battle occurs. Much has been written already on the subject identifying potential doctrine for strategic, operational, and tactical employment of information based weapons.[5] Current military tasks that seem to be associated with the information war seem to have fallen to the special operations forces in the past. Indeed psychological operations leaflets, civil affairs instruction, and foreign internal defense forces already deal with affecting and shaping the mind of the target population.[6] Some believe this new form of warfare will render previous forms obsolete.[7] The official military position reflected in the Draft Joint Pub 3-16, "Joint Command and Control Warfare (C2W) Operations," discusses command and control warfare in terms of five areas; electronic warfare, deception, psychological operations, operations security, and physical destruction.[8] Clearly, the resource and tool of information is evidenced in the first four categories of activity and also the last, if precision destruction with the smallest amount of unnecessary collateral damage is required. Each of these areas of warfare described in the joint publication is an extension of prior knowledge of warfare, therefore an evolution. If the information resource is viewed from a larger context of control of

the masses, then information warfare is a revolution in the tools of war. Revolution here is defined as "an assertedly momentous change" using non-lethal and precision weapons aimed at specific target groups. Thus information warfare is not limited to command and control warfare and the current missions of special operations forces. Indeed a whole new field of prediction, control and influence is now opening and begs exploration.

The new field of study, information warfare, that awaits must be understood to assure national defense. Others may acquire power projection capabilities aimed at controlling the masses with information weapons. The revolution rests on the recognition that the information resource is not just about new technologies, new hardware, higher, bigger, longer, faster, better gadgets, or more "ilities." Information is about the perceptions and thoughts that result in decision making by the human mind. This process has been described by John Boyd's observe, orient, decision, action (OODA) loop model shown in Figure 1. Note that Boyd places great emphasis on the orientation block because of its significance and the magnitude of the activities or processes comprising orientation.[9]

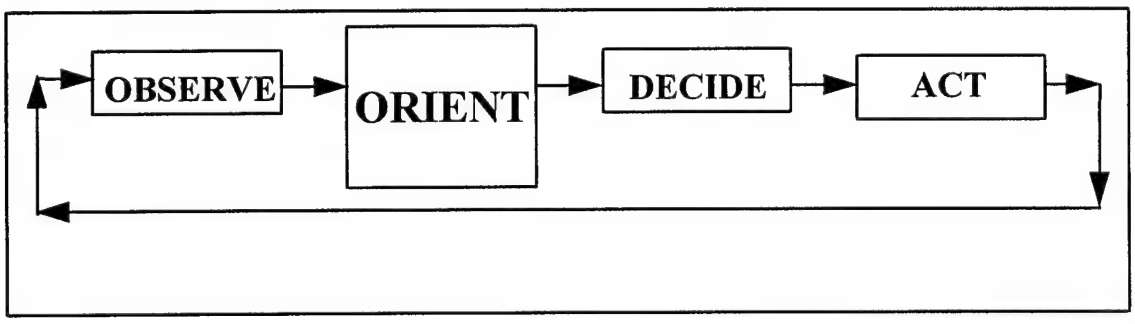

Figure 1: John Boyd s OODA LOOP [10]

The essential task of the warrior would be to operate faster in the loop than the adversary. I contend the issue is not so much operating faster than an opponent as it is controlling the information contained in the opponent's OODA loop. The consequence could be faster operations, but speed alone is not the goal. Shaping the *actions* of the adversary by forcing adversary *decisions* down a set of known or expected logic paths using knowledge of the adversary's *orientation* while controlling what the adversary *observes* is information warfare. This is beyond our current understanding of command and control warfare.

Beyond C2W

The five elements of command and control warfare address what the adversary observes. Intelligence agencies merely attempt to understand and predict orientation of the adversary. Psychological operations and deception attempt to affect orientation in the short-term to produce some kind of temporary tactical advantage. This appears to be the point where our current operational information warfare capacity ends. Setting aside the issues of legality and morality, albeit critically important issues in our country, it would seem that other operational capabilities might be possible. To fully understand information warfare we must understand, integrate, and perhaps intervene along the entire continuum of the information process, not just at or in the adversary's observation and orientation processes, and not just when fighting commences or appears imminent. If there is a science underpinning information warfare beyond command and control warfare, awareness of that science is not confined to the United States.

A key question is, "What are the non lethal tools that can be used today to achieve manipulation and ensure power, thereby providing security against any adversary?" To preserve the security of the power we currently enjoy, we must master information better than a future adversary. Toward that end this paper will address the issue of mastering information and providing the tools to operationalize this new form of warfare. The term that I will apply to the task is "information engineering" for the purpose of information warfare. To understand the central thesis it will be necessary to discuss relevant aspects of psychology, sociology, and physics in individual chapters. Using these insights as analytical components, I will synthesize them in a model of information engineering and control. Non-lethal applications of this model will also be examined. If we take the psychology of the mind, add the sociology of the masses, use the vision provided by the physical sciences and integrate them into a model allowing the precision employment of the non-lethal tools of information warfare, the result should be insights into information engineering for the twenty-first century warrior. None of this is possible unless the question, "Do physical laws apply to information?" can be answered in the affirmative. The first chore is to demonstrate that information engineering is commensurate with the other engineering disciplines.

THE MIND

When Thoughts Collide

Aiming at the Processor

To begin the study of information engineering it is necessary to start with the most basic and fundamental information processor, the human mind. Understanding how the human mind processes information will provide a microscopic view of the information engineering model. The collection and processing of information by the brain and the resolving of conflicting information data are the essence of the model. From the information warrior's perspective attacking the human mind with precisely constructed and manipulated thought would be analogous to the simplicity of hand to hand combat. This field of study is cybernetics, the command and control of communication in living organisms.[11]

The Brain

The brain is physically a chemical and electrical biological organ and device. Many comparisons to basic computer hardware have been made to understand the brain functions. These associations most often compare the brain to the central processing unit of the computer system. The brain is actually an aggregate of functions that provides for the processing and subsequent responses to all information observed by the five senses. Additionally, the brain manages the memory function for both long and short term storage. Memory writing is believed

to be independent of genes and a function of biological mechanisms that are consistent for all humans.[12] Memory can be understood in its simplest terms as a process wherein the component parts of a thought is disassembled and then stored for later retrieval. This serves as the data base for the orientation or baseline reference for the decision process.

The decision process results in "thoughts" or conclusions derived from comparisons made between the observed input data and the reservoir of existing information in the orientation data base data. This process has been described as "collecting information from the outer world at low energy levels" and then transforming it "into a new form available for further stages" of processing.[13] Thoughts are therefore newly created information packets and are physically manipulated in the brain with chemicals and electrical signals. These signals are transmitted through changes in the nerve impulses.[14] Nerve cells are estimated to number 13 billion and they appear to operate by a process similar to sending burst of signals that are analogous to dots in the Morse code.[15] The thoughts are in fact information represented in the form of chemical and electrical energy changes. However, the new information thoughts are transformed and are not just the one-for-one manipulations or substitutions of symbols that mirror or correspond directly to the external world of reality.[16] This means that a new observation does not necessarily mean a new thought. Sensed data must be compared and connected to existing data already stored in the brain. Said another way, the brain transforms sensed data into an aggregation of separate elements; an information packet.

Information Packets and Waves

If the newly observed information packet is in conflict with previous orientation information packets then the conflict must be resolved. The resolution of this conflict causes one of the two information packets to be labeled "false" and stored as such. It is therefore possible to alter the memory contents of the brain by introducing new and different thoughts that are in conflict with the previous thoughts, forcing a conflict resolution that results in a favorable state with respect to the desired information packet to be retained. Said another way, new thoughts can displace already stored thoughts, if the new thoughts are properly engineered or constructed.

For optimum efficiency the new thought or information must be constructed so that it is specifically and uniquely matched to destroy the previous information packet. For example, the information that a car gas tank has an adequate fuel supply (a present thought based on observing the fuel gauge) is completely destroyed after operating the car for some distance and discovering that the fuel gauge is inoperative (a new thought based on a new observation). A physical analogy to this process is in the field of wave mechanics.

In the physical science of wave mechanics a wave pattern can be rendered null with the appropriate selection of an interference wave pattern that perfectly cancels the original standing wave. By matching frequency and the inverse of the amplitude the waves collide to zero-out or cancel the resulting values. These techniques are already highly developed in the field of digital signal processing, where Fourier analysis and other mathematical techniques provide the capability to break down a complex signal into component parts. Matching anti-waves can be constructed to perfectly null each component part in digital signal processing. The same may be true for thoughts. Specific identification of the thought to be canceled is theoretically possible using the

technique of matching the power spectrum of the signal (a new thought) for the purpose of pattern recognition and unique identification of the existing thought targeted for destruction. Additionally, and applied to human thinking, the objective would be to add a new wave that becomes the "empirical wave," the "truth" for the observation, and subsequently results in alteration of the memory of the wave that is already present and had been previously accepted as something that was true or real. Viewed in this light, "forgetting" may be either the inability to access existing data or the cancellation of data that once was present, but had been replaced by new data.

Is it possible to scientifically determine the frequency, amplitude, or other parameters that compose an information packet or thought? The physics of destructive or constructive interference is simple once these parameters are documented and a thought is measurable in terms of these parameters. Science already accepts that information is a measure of regularity of a particular pattern that is formulated to convey the message from individual to individual.[17] Since the information packet is manipulated with chemicals and electrical energy signals, the answer to the question, "Can it physically be done?" is "Yes," but the parameter set is the key to the puzzle of documenting the patterns.

Wave Mechanics and Information Packet Analysis

Previous medical studies of brain processes indicate that wave mechanics, including such terms as resonance, vibration, and propagation, apply to semantic information concepts.[18] Furthermore harmonic analysis of brain activity using Fourier series analysis resulted in empirical

correlation of certain types of waves with certain thoughts.[19] The application of these mathematical techniques to semantic information is not new. The brain contains

> certain foci that are connected on the basics of some correlation or similarity; these foci have specific semantic spectra with a certain characteristic of probability, and if they are strengthened by some stimulus, they transmit their waves into their vicinity and combine in various ways.[20]

In simpler terms this can be described as the process of "information packet analysis," wherein information packets are separated into component parts, propagated as a wave, with the reassembly or synthesis of the information packet later as new information. Unfortunately, precise identification of all the parameters that compose the semantic spectrum and would serve as the building blocks for information packets are incomplete. However, in today's computing environment the volume and size of the data that can be processed are much larger than in the past, giving hope that more complete or even total analysis and computation may be possible in the future. Is this an insurmountable problem, or one that stymies information engineering?

Enter Statistical Processing

The brain complexity is enormous and therefore the analysis must resort to estimation and statistical methods, as is the accepted practice in the analysis of other complex areas. Since the total documentation is incomplete "the mathematics of the nervous system and of cybernetics must be statistical and non linear."[21] Even so, statistical predictions can be tested using empirical relationships between sensory input and behavioral output. A recent medical study, for example, linked observations of violent activity to subsequent human behavior in the form of violent activity. Emotional responses and therefore information such as being scared, happy, and sad

were predictable based on the visual stimulation of the subject.[22] As additional research is done attempting to determine the relationship between sensory input (violence or visual eroticism, for example) and behavioral output, these relationships will become better understood. Established linkages between sensor-received data for decision making and hence action or behavior supports the concept that information packets propagate and flow as waves within a system. Thus, rudimentary information engineering, albeit presently imprecise, is already possible, while continued research affords the opportunity for greater and greater precision. Understanding sensory input is the next step in building the engineering model.

Sensors

The next issue to address is how the information packets enter the brain processor from external sources. The simple answer is through the five human body senses of sight, hearing, touch, smell, and taste. These are the channel or medium for the transmission of data to the brain for its complex decision process. The most active of these sensory channels are assumed to be sight and hearing, presently understood as the principal means for gathering the observations that become information packets. However, there is no evidence that the other channels are significantly less powerful in their ability to propagate information to the brain. In fact they are just less understood and to the information engineer or warrior offer perhaps a niche to gain access for infusion of the created information packets that need to be inserted into the mind of the adversary. Examples of hostile uses of noise as an input to the sense of hearing span from artillery rounds fired short to create the frightening sound of ricochets, the use of whistles on aircraft, to loud speakers playing music at the Branch Davidian compound in Waco, Texas. While each of

these uses of sound does not appear to be precisely constructed to elicit a specific or predictable adversary behavior, there is evidence that they affect adversary decision making and hence actions.

Lastly, as another channel or sense there is some evidence of extrasensory perception (ESP). This is believed to be the direct transmission of thoughts without using one of the known five senses. If this phenomenon exists, then the information packets have to be converted into a form that allows for transmission that does not utilize one of the five senses as media for transportation. One possible explanation of these phenomena is conversion of the information packet to an electromagnetic form for transmission. A physical analogy is light, where energy quanta are transmitted without a medium required. To some this provides one explanation for "fields," or the voids or vacuum absent of matter and heat but containing distinctive patterns of electromagnetic radiation.[23] The encoding and decoding process for extrasensory perception, if it existed, would require knowledge of the information packet parameters, as with all the senses, described earlier. Should extrasensory perception exist, this method would offer the most elegant mechanism for the information engineer or warrior to infuse information, since it is not burdened by the physical senses' limitations imposed by the transmission medium existing between the source and the target.

Another important consideration is the capacity of the receiver. A possible limitation of the receiver is the channel capacity of the brain receiver to collect information from the various senses. Just how many information packets per unit of time can be processed and what sensors have priority over others would be useful information to have. This category of knowledge would help prescribe the overall strategy of the attack for the warrior. Such information helps us

understand the consequence when competing information packets arrive at the same time, or even when sensors are flooded with information that is of no use, but overwhelms or out prioritizes the primary channel that the adversary is using. For example, the flooding of the hearing sense with noise may be a tactical weapon to compete with "normal" sounds, while a second sense is use to feed desired inputs. If the second sense also becomes flooded, then a third must be chosen. By knowing the priority of sense selection, appropriate (that is best, better, or more effective) channels can be selected when competing information packets are attempting influence simultaneously. Said another way, it may be possible to use visual data such as flashes of light to overpower olfactory data, or sounds to overpower taste. Acquiring a knowledge of the prioritization schema ought to be possible because we already know that the reticular activating system (RAS) filters and monitors all senses to select the observations that will pass.[24] Thus separate receiver and observation processes exist. This issue and its significance will be discussed in the detailed description of the information model.

Information Warfare Utility

The military field of psychological operations skirts on the edges of the concepts of information packets and their manipulations as already discussed. The primary difference and limitation of psychological operations currently may be the approach that attempts to simply add a positive information packet over the existing information and orientation of the target. The destructive interference phenomena that occurs when thoughts collide are not fully utilized by psychological operations. Instead, the new information packet is pushed with large amplitude in an attempt to simply overpower the previous information by brute force. By incorporating

destructive interference techniques efficiency is gained and the new information packet could be propagated and observed with a significantly less amplitude. One obvious advantage of this approach is that it would bring less attention to the psychological operation, constituting a sort of "stealth technique" for the information warrior. For example, instead of loud music at a high decibel level, it might be more effective to use precisely selected music to elicit a particular and predictable emotional response, thereby more precisely shifting the adversary's thoughts away from or to a particular focus.

The second difference and perhaps most important between information engineering and psychological operations conducted today is in the area of the orientation of the decision maker or any other target. Current psychological operations doctrine utilizes the input of new observable data aimed only at an immediate or short-term outcome and decision, and fails to target the more powerful and persistent orientation baseline. The modification of the existing data base that is possible with the information techniques described here, allows for changes to the orientation baseline of the target thereby affecting the adversary's decision making in both the short- and longer-term. In the most elegant form these alterations would be resident in the orientation until needed to affect the critical decision making that one wanted to influence. The learning of the target and adjustment of the target's orientation is classically referred to as psychological behavior modification.[25] Thus when the adversary is faced with a decision, his or her orientation would cause a decision that is more useful to the aims and objectives of the friendly warrior than the adversary. Moreover, there would be no requirement for the infusion of new observable information at the time of the decision. Thus it would be possible to "win" without physical force, win by influence before the battle by deluding the target through the "loss of independent

verifiable reality."[26] In other words, by shaping the adversary's orientation data base in ways useful to friendly forces, the shaped orientation would predispose an adversary to think, decide, and consequently act within a predetermined range of ways.

In summary, the microscopic view of the information engineering problem resulted in the conclusions that information packets are formed by previous and observed data, that these packets are transmitted like waves, that these waves are observed by sensors, and that the receiver is the human brain. Moreover, the engineering system must be analyzed statistically because it is very complex and non linear in nature. Psychologists have studied empirical results extensively and the techniques are generally aggregated in the field known as behavior modification. To understand the individual susceptibility to information warfare one must use already extant knowledge from the field of psychology and add the engineering process and structure to the model.

THE MASSES

Neocortical Network Control

Social scientists have studied the culture and civilizations of the past and present to learn of the forces affecting those civilizations and the consequences of those forces. The area of common ground for the separate sets of analyses appears to be awareness of the competing effects of collective consciousness and control with individual determination and control. This control of group or individual consciousness may be voluntary or it may be the forced control of the parties by a coercive means. Minds may be controlled by controlling minds or by controlling the bodies that host minds. In either case, the aim is to exercise an effective degree of control over the human neocortex. Neocortical control, to the degree that it is coercive, is not a control system that admits much self determination. It is similar to the Soviet reflexive control theory that states

> control of an opponent's decision, which in the end is a forcing of a certain behavioral strategy on him through reflexive interaction, is not achieved directly, not by blatant force, but by a means of providing him with the grounds by which he is able to logically derive his own decision, but one that is predetermined by the other side.[27]

The non-volitional control of individuals and groups within a population, by an outsider, without the use of force is the concept of neocortical network control. For the warrior "meeting national security political objectives without force...(is called) neocortical warfare."[28]

Sociology and Group Dynamics

The social scientists have offered several architectures that define or organize individuals or groups into societies or civilizations. Social science also seeks to understand what causes these societies or civilizations to evolve and change. Sakar offers a model of society composed of the laborers, warriors, intellectuals, and acquirers as categories for people.[29] The Tofflers model the waves of three societies: agricultural, industrial, and information.[30] Huntington proposes a model with religious beliefs as the organizing principle for differentiated civilizations.[31] Still other models exist that are based on categories of politics, education, and wealth. All of these models attempt to identify categories, including those evident today and those that existed in the past civilizations or culture. Each model uses groups to describe individual associations for a particular preference set in the form of social structure. The groups set conditions and influence the behavior of the larger mass that becomes characterized as a differentiated society. What each of the models is seeking to explain is what makes individuals adhere to a category or group and thereby relinquish some degree of individual freedom to group control. The bonding agent, or that which holds the masses together in a group, is a key indicator for learning what holds individuals within a group and what holds a group together. It may be that knowledge of that bonding agent, properly exploited, provides the power to control the group. A conclusion that can be drawn from the study of existing social science models is that the bonding agent can be described as common thoughts or information packets and the knowledge or awareness that other individuals in the group share the same or very similar thoughts. For example, the shared ideology of democracy by the Western cultures offers a common bond between populations spanning across political boundaries and persists because of or even in spite of conflicts in the

past. Collectively the masses form a group of some important shared interests. Thus they share a cognitive or affective glue that bonds them together.

These common shared information packets form the basis for the group orientation and as such establish the parameters or limits for decisions that the group must make. Viewed in this light the masses then become a network of individuals with a common orientation. Adversary knowledge of the network interests allows, or may allow, for possible control of that network by "purposefully influencing the inputs" from the environment.[32] In Weiner's words, "If we understand the mechanism and motives of the group mind, it is now possible to control and regiment the masses according to our will without their knowing it."[33]

Add to this the awareness that "a group may have more group information or less group information than its members,"[34] and two additional conclusions are possible. One, that the total body of information or knowledge available forms a reservoir for members of the groups to access. There is "more" information available to the group than is used by any single group member. Second, that some decisions are made by individuals forming new information not shared with the group. There is "less" information available to some members of the group, because others are creating or generating information not known to or shared by the group. This suggests that decision making can occur without generating actions observable by other group members. The effect of these kinds of individual decisions and actions is that they limit and thereby affect the shared information reservoir of the group. A group orientation or attitude, sometimes called "groupthink," is stronger and more difficult to change than individual orientation.

The synergistic effects of group sharing of information contribute to the cohesion and strength. At the same time, behavior of individuals becomes more predictable due to their association with the shared orientation of the group.[35] For example, the predictability of voter outcomes based on their regional location and grouping and the strength the group gains from the association offer support to these conclusions. It should be noted that individuals can be members of numerous networks and that numerous networks exist to serve specific interests or causes.

It is essential to attempt to understand the group's orientation and how it changes. The indications are that the principal source of the group's orientation is the environment. The environment is the "place" from which the group and its component individuals observe the available body of information and is therefore an important source of input to the process of decision making. According to Barker's theory of behavior setting "we are apt to act in certain ways in certain places; the more clues a place provides about what we should do or not do, the more we will conform to them."[36] This indicates that there may be a strong connection between observations and group orientation. It also suggests that once the group orientation is formed it is difficult to change. Even when an environment may be artificial "the more we experience in a behavior setting, the greater its power to alter our perception of the real world."[37]

Changing group orientation is not only possible, albeit difficult, but the strongest tool for changing group orientation will come from within the environment to which the group is accustomed. Thus, the engineer will look to characterize the operating environment as it affects the operation of the model. The warrior may conclude that since the orientation of an adversary can be changed by using new inputs to observation, there is not an insurmountable wall of

biological structure to overcome. The validation of the engineer's search and the warrior's conclusion may come from the world of competitive advertising.

Advertising and Marketing

Examples of organized attempts to control group neocortical networks, and hence group decision making and behavior, reside in the fields of advertising and product marketing. Here information handlers, prototypical information engineers, use the advertising tools of various media in attempts to guide the target network to decisions that are profitable to the advertiser. The decisions are group in nature since the entire group mass is influenced to take actions such as the purchase of a particular product.

It is important to note a distinction between "marketing" and "advertising." *Marketing* is understood as the process of introducing information packets of knowledge about a product or a subject. Marketing therefore forms the baseline memory or orientation about the product or subject, thereby beginning "to play a more subtle role in changing habits than merely stimulating wants."[38] Women's magazines attempt to convince, train, or orient the readers as to how they should dress, decorate, and eat certain foods. *Advertising,* on the other hand, is the process of reinforcing a generalized information packet with more specific facts that present the product or subject in a favorable light. While marketing may promote a style or fashion for dressing, advertising aims to convince the reader that a specific brand-name product best exemplifies the style marketed. Advertising aims to cause a specific decision to be made based on the orientation from marketing and the new data from the advertisement. For example, the advertisement of

beverage and food snacks at the start of a movie is advertising, while the information marketing orientation produces knowledge or awareness that a vendor is located in the lobby of the theater.

Visible and obvious information is not the only content of an advertisement. "Silent information accompanies every sale," such as the concept of motherhood with Campbell's soup.[39] The professional information handlers already are expert at characterizing selected groups for the purpose of niche targeting, selecting a group possessing common information packets or a common orientation. The first step is to always capture the attention of the target. The next step is to make an impression that causes a decision which brings about overt action with respect to a product.[40] The application of these techniques to the field of information warfare requires us to understand the orientation of the groups that exist as adversaries and additionally to comprehend their network orientation as it applies to group decision making. By using this knowledge the information engineer can help the warrior introduce information packets that attack or even destroy undesirable orientation and thereby create a new orientation. Once the orientation begins to shift or a new orientation is in place, the warrior can advertise to reinforce with a new information packet that affects the decisions made by the adversary. Obviously, decisions that conform to our objectives or inhibit the adversary's would be the goal. A challenge is possessing the means to confidently determine even subtle changes in orientation. Individual behavior may not provide valid data. Group behavior would be a more valid indicator, but all behavior occurs after the fact. Thus causal relationships cannot be forecast in the absence of empirical data. This data exists in advertising and marketing.

Advertising and marketing indicate that the magnitude of change that can be brought about be a single message appears to be a function of the orientation distance magnitude between

the target group and the change observation message. "Laboratory studies provide definite substantiation for the belief that the greater the divergence is, the larger the attitude change created," despite surveys to the contrary.[41] Thus the greatest influence occurs while attempting the largest change which often has an appearance of a large shock effect. The attitudes of United States' citizens toward the Japanese provide an illustration. Whatever was the dominant attitude toward Japan and the Japanese prior to the "sneak attack" on Pearl Harbor, there can be no doubt that the shock effect of a surprise attack changed American orientation immediately and profoundly. In the wake of the attack, even loyal Americans of Japanese ancestry were interned as political prisoners. After four years of war with the Japanese, the orientation of many Americans was altered permanently. Thus, shock is or may be an effective form of advertising aimed at changing orientation.

The conclusions for the warrior are that the principles of advertising influence group orientation and that it is not just new observations that result in changed behavior. This is true because humans appear to be belief- and value-orientation seekers by their nature, and search for group affiliations as a source of values and beliefs. Advertisers promise benefit and offer hope of a better way.[42] Advertising succeeds because it influences orientation.

Atypical Sensor Use

Use of the visual and hearing senses are the obvious channels the advertising information handlers use. Printed material has lengthy exposure time while television and radio offer single presentations.[43] This is an important consideration for the warrior. One must choose the correct

medium based on the intended duration of exposure to the weapon attacking orientation. Lengthy exposure can be achieved with printed material if the objective is to change the orientation over the long term. For short term tactical application, using other more perishable media would be more appropriate since these provide for flexibility in weapons employment. Moreover, these more perishable media may provide less evidence of activity than a less perishable one. When Hitler authored *Mein Kampf* in an attempt to change orientation in the long term, he provided permanent proof of his hostile designs. A book aims at a larger target set and has more persistent effects, for example, than conversations aimed at an individual.

The other three senses of touch, smell, and taste also are used in marketing and advertising. Examples include the marketing of toilet tissue using touch, perfume advertising in magazines aimed at the sense osmell, and small free samples of particular foods in grocery stores appealing to taste. These examples and others offer support that the warrior in the information battle will need to transmit information packets using all known channels available in the spectrum of human sensors.

In the education field there are examples of successful education of individuals with impaired sensors. The learning of speech by the hearing impaired is a perfect example of utilization of other sensors to acquire a skill, speech, which normally is only learned by mimicking. This ability to transmit the speech information packets to the target in a form completely different from actual speech supports the theory that the information packets are not tied to medium of transmission. It is very important to note that the information packet characteristic is independent of the communication channel and can be transformed to allow for transmission on *any* channel using *any* receiver sensor.

Mass Processing: Individual Processing Writ Large

Within the jargon of advertising a commonly used word is "mass." If the warrior is to benefit from information engineering, it must be applicable not only to individuals, but more importantly to the group mass of the adversary. In a totalitarian sense an old term that applies would be "mass brainwashing."[44] The extension of that concept as it applies here would be that crowds or large groups are easier to influence because of their common longings and yearnings and the power of group suggestibility. As the individual becomes integrated within the group, it is easier for the individual to also become susceptible to or even a victim of "mass suggestion."[45] This suggests that creation of artificial groups and associations within a larger group may provide a source to gain power within the network as a whole. For example, creation of a subordinate group cause or focus within a larger group would be acceptable to the larger group, at least initially. Once established, the sub-group evolves until it becomes dominate and overpowers the larger group making the important decisions for the masses. The old adage "if you can't beat them join them" can be completed by adding a clause, "And then win the battle from within."

Specific techniques of mass manipulation include employing "specially suggestive words" and then "repeating them monotonously."[46] The powerful words are chosen to be especially meaningful to the targeted group and the monotonous repetition can employ more than one human sense. For example, an indeterminate number of United States citizens were opposed to continued employment of United States troops in Vietnam. This sub-group had numerous representative sub-groups on college campuses. Mass rallies, posters, and the mantra, "Hell no, we won't go," intruded into the visual and hearing senses of the larger group. The target was the cohort of draft eligible students required for continuos intervention in Vietnam. Over time, the

message affected the orientation of many in the larger group. Thus the unique design of the information packet tailored to a specific target with sufficient dwell time on the target will likely be more successful than a non-precision barrage information. These techniques are especially effective in nations with representative forms of government, because "the will of the people," including people in large sub-groups, cannot be ignored easily.

Another technique is to arouse hysteria and use shock to "homogenize the emotions" in the mass.[47] Just as in the individual case, where feedback from the consequences of decisions helps shape or replaces orientation, evidence exists that group feedback operates in a similar fashion. Thus, as the students opposed to the war in Vietnam observed that their protests were enlarging the sub-group, they increased their efforts and added sub-groups of parents, returned war veterans, clergy, and ultimately influential politicians. The "shock" of photographic imagery from the war and personal testimonies increased the power of the anti-war sub-group. Group feedback represents an iterative process, occurring even as information and decisions are formed. For example, in a televised courtroom situation as an examination of a witness occurs, the group public observation of the examination may influence the outcome by becoming "part of the courtroom atmosphere."[48] The coaches of sports teams have long considered the "fans" as "the sixth person" on a basketball team or "the tenth person" on a baseball team. The fans provide feedback and become part of the process of the contest. Thus, one can draw the conclusion that the knowledge and principles of information processing in mass and group operate and can be modeled in ways similar to that of the individual brain.

Spin and Propaganda

The particular information handler terms of jargon, "spin" and "propaganda," appears to warrant some discussion within the universe of the evolving model. First, *propaganda* may be defined as the systematic effort to persuade using mass media to communicate disinformation.[49] Another view is that of "organized persuasion."[50] More precisely, propaganda is the marketing of information packets for the purpose of developing a marketing base of orientation to support unique information packets. As noted earlier, propaganda usually commences without the fine analysis necessary for matching its information packets in such a way as to ensure destruction of specific aspects of the information packets forming the existing orientation. Propaganda is the brute force technique that attempts to overpower the existing condition with amplitude. A criticism of propaganda is that "the intensity and nature of propaganda is largely uncontrolled, it is hard to equate the results obtained."[51] The reaction or re-orientation of the target to propaganda is believed to occur in two possible ways, by generating apathy or indifference, or by creating a desire to study in the target.[52] Neither of these may be particularly desirable or useful when considering the overall effectiveness of the effort. The recognition by the target that it is being subjected to something easily recognized as propaganda is possible since the new information packets are imperfectly matched for cancellation. For example, the campaign to demonize the leadership of Iraq in the fall of 1990 was effective to some but not all of the United States public, and certainly not all of the Middle Eastern public, including those that subsequently became allies in the war that followed. The anti-Iraq message was too broad to be perfectly matched for achieving the desired results in the orientation of all that received the propaganda. Nonetheless, it was effective enough to have impact on a large mass.

Spin, on the other hand, is the attempt to take an existing information packet and modify it so that it is not totally destroyed or canceled. Selective parts of the information packet are retained and enhanced, while other parts are destroyed. Spin may be thought of as the creation of "half truths." There is some element of "the truth" in half truths, but the information packet of a half truth still constitutes a falsehood. The newly created information packet in spin thus has an association with the first message and in effect serves as a collective reinforcing agent, just as marketing supports advertising. Precise, or more precise, spin creation is certainly possible physically by means of the same mathematical techniques described earlier, and can be done effectively if the information parameters that compose a packet are known. Spin is therefore a good counter-offensive weapon in information war where propaganda is employed as a poorly executed brute force offense. For example, politicians are often accused of never answering the question that is posed to them. Instead they take a keyword or phrase from the question and use it as linkage to the subject that they wish to discuss. This process of enhancing some keyword idea and diminishing non-key information for the purpose of controlling the conversation or subject demonstrates a technique that can be modeled and employed by sophisticated information engineers.

Control of Adversaries

As discussed earlier, the group networks with common shared information packets are numerous and the combinations can be infinite, if we assume that an infinite amount of information exists or can be created. These networks are not necessarily allied or associated with any particular government or nation that might exist today. Thus, the simple conclusion is that

the adversary in an information war will not or at least need not resemble the kinds of adversaries the United States faced in wars or conflicts in our past. In the future, conflict with groups may increasingly be with non-state groups; groups whose orientation and aims are based on a bonding agent that is independent of politics. If the conflict is not over territory or borders, but over "resources" in the larger sense, the object of fighting could be the information resource or even information dominance. In either case, the adversary's handling of information at high rates for influence and power becomes a target or even the target. If information is a target or weapon in wars of the future, this "force" must be projected and it must be employed at a high tempo. Rapid, fast paced "hypermedia automates scholarship (the finding and linking of information) thus making available to amateurs the resources once produced and consumed solely by small groups of specialist."[53] It would be unreasonable to expect that "hyper-information" will not provide the same advantages.

Just as non-state adversarial groups can change the character of warfare, the recognition of an adversary not armed with the traditional physical tools of war may constitute the most significant threat to the warrior in the future. By the time the recognition of hostility or a threat occurs, the damage inflicted may already be too great for recovery. The power to control the network and force group decisions as desired is power that effective employment of the resource of information packets provide. As with all previous powers that have become available to humankind, power comes first to the elite then passes through gatekeepers before being disseminated to the masses. Thus, elite sub-groups of all kinds--governments, religious groups, armed forces, intelligence services, commercial entities, and some individuals--may possess information capabilities superior to those possessed by the masses. Elites have the willpower and

the resources necessary to acquire new capabilities. Any one of these elites may be capable of hostile action. Understanding the evolution of power and the employment of new capabilities is illuminating.

The transportation evolution of the twentieth century offers insight. The power elite owned and used the productivity of trains and automobiles first. Only after full realization and exploitation of capability was access allowed to the masses. Additionally, the airline industry gatekeepers controlled access by artificially high priced economic practices until deregulation in the 1970's forced competition allowing the masses to fly. Evidence of control and dissemination by gatekeepers is displayed by the fact that media is purchased by countries, imported, and distributed top down for elite uses rather than produced from within.[54] The power of information packets is no different. It offers power to those that possess information wealth, while the networks under control have the status of being information poor. Two observations are possible: one, power elites will be the adversary; and two, because information technology is ubiquitous, the adversary could be as well armed as the power elites in the United States.

In summary, macro analyses suggest that the orientation of networks or groups function in the same way as individuals possessing a group affiliation and orientation because of the synergistic effect of the group. Said another way, the whole of orientation is greater than the sum of the parts. This means that the information packets residing in individual minds can be accessed through the individual mind or through the group in which the individual is a member. Bonding, flocking, and other human tendencies make individuals more vulnerable to changes in group orientation than to changes in individual orientation. Not all the information packets possessed by individuals or all the decisions of individuals within the group are revealed to the group. Thus

individuals within groups and smaller groups within larger groups may have an orientation that may differ in important respects from the larger body of total information. The observations of the surrounding environment are the main basis of orientation, and orientation is not a predetermined innate characteristic. Marketing and advertising principles can be used to alter the group orientation by using all the same senses that human individuals use. Spin, false information arising from the modification of accurate information, and propaganda, or brute force information packets with large amplitude, can focus attention on new information packets. Creation of an interest in an important sub-group within the larger body of a group is a means to penetrate the entire network and perhaps ultimately gain control of the network Power elites are important sub-groups and may be targeted directly, or indirectly through the masses or networks they control. The next step is to systematize these principles by applying scientific techniques.

PHYSICS and MATHEMATICS

Analytical Information Science

Recall that information packets are composed of chemical and electrical signals within the human brain and are transmitted physically by communication channel mediums that certainly have physical properties. Moreover, information in the smallest form can be represented mathematically as a single bit or condition state. That is, it is the true or false, on or off, one or zero state of a particular condition. This represents a single bit of information.[55] A bit is the fundamental building block for the mathematical representation of any information. Information packets would then be composed of numerous bits of information that represent the condition states possible within the fundamental building block parameters that compose the information packet. Examining the properties of information from an analytical approach and treating them as physical material that has physical properties will allow scientific tools to handle information. Two important caveats must be noted: first, "Newtonian physics is not the proper frame for biology,"[56] and second, the analysis required is awesome in its complexity. Quantum mechanics may help us analyze the small energy information packets, and the high power mathematics of statistics may explain the non linearity affecting information.

Shannon identifies three levels of communication's problems that apply to the transmission of information: the technical, semantic, and the effectiveness problems.[57] The technical problem deals with physical transmission accuracy and includes such issues as the symbols used and the channel medium. The semantic problem addresses the interpretation of meaning by the receiver

when compared to the transmitter. Finally, the effectiveness problem concerns the success with which the meaning was conveyed to effect the actions of the receiver. Shannon also concedes that the three categories overlap in reality and practical analysis, and that a single theory of information exists that spans all three categories.[58]

Analyzing the processing of information packets from a technical view forces the conclusion that information is a measure of the amount of variance or "choice" a particular message has. If two variants or choices are possible for a message then a single bit of information is needed to mathematically represent the choices. If four choices were possible then two bits would be necessary for mathematical representation and so forth. Each of the possible choices has a certain probability of being selected. If the choices at any given point in time is dependent on the past choices, such as the orientation of a decision maker or group, then the system is a Markov stochastic process. Thus, a systemic approach is mandated. One challenge all complex systems face is the challenge of entropy.

Entropy

As discussed earlier as two or more pieces of information are combined to form and create additional new information packets, the quantity of information grows. This increasing information phenomena conforms to the physical science concepts of entropy. First introduced by Clausius in 1865, the concept of entropy was intended to distinguish the difference between conservation of energy and reversibility.[59] In thermodynamics the increasing entropy of a system corresponds to the increasing amount of disorder in the system. In an information system this is

also true because the "amount of information is a measure of its degree of disorganization, so entropy is a measure of disorganization."[60] If the system is highly organized with little choice, the entropy is low. In the case of a single bit of information with two choices, the entropy is maximum when the probability of the choices is equal at one-half since the maximum amount of choice equates to maximum disorganization. If one choice was of probability zero and the other a probability of one, there would be no randomness or choice in the system.

A mathematical function developed to measure entropy or choice of a system is the Kolmogorov-Sinai or Hamiltonian.[61] Extensive work in this area has been documented by Bing-Fei Wu, where conservative, chaotic, and stochastic system entropy is calculated.[62] For information packet system analysis one must determine if the system is chaotic or stochastic.

For the irreversible systems of nature in our universe "the total energy in the universe is constant and the total entropy is continually increasing"[63] and cannot decrease. Since the formulation of new information packets and choices creates information and the un-forming of packets is not known to occur, the information system is also irreversible and would be an increasing entropy process. Note the un-forming of information packets is distinctly different from the destruction of information packets through analytical interference techniques. Un-forming would be breaking the information packet into the two or more component information packets that formed it and returning to the prior state of existence, thereby reversing the formulation of the new information. "Rewinding" the data, reversing time, is not possible for the information packets once they are formed. With an information system of increasing information entropy, the level of disorder grows as the quantity of information grows. The term "chaos" is sometimes substituted for the word "disorder." Thus as new information packets are formed by

combining existing information packets in the irreversible process described here, the amount of chaos in the system can only increase. However, in a strict mathematical sense the system must first be identified as a chaotic or stochastic one, before a proper, operational description is possible.

For construction of information packets and the choices a system has, increasing entropy indicates that a "message can lose order spontaneously in the act of transmission, but cannot gain it."[64] These entropy properties are important to the extent that "the main purpose of studying entropy is that it provides a new tool for assigning initial probability distributions."[65] This in turn enables the information engineer or warrior to define and establish the initial orientation probability distribution of the adversary future choices by understanding the adversary's current state of entropy.

System Choices

As choices are made and new information packets are formed, decisions are being made either by an individual mind or a group in the form of a network. These decisions are based on the orientation data base and the new stimuli of new information. The possible outcomes for a decision could be single or multiple new states of information packets. These outcomes are the potential choices and represent the branches or new states that the decision may lead to. The highest probability outcomes are referred to as "attractor states" as they lure or draw the decision maker to select that high probability choice. These attractor states are favored by nature and systems will tend to move toward them by selecting choices automatically or of its own "free

will."[66] For example a die that is rounded so that a particular face is more likely to come up has an attractor state for that face. A coin toss has two attractor states when compared to the probability of landing on its edge. The mathematical representation of this information formulation process is captured by the statistics of Markov chains. Although the mathematics of Markov chains allows for a reversible process the application of the Markov chain, as shown in Figure 2, analysis must be limited to the irreversible information processes that exist in nature.

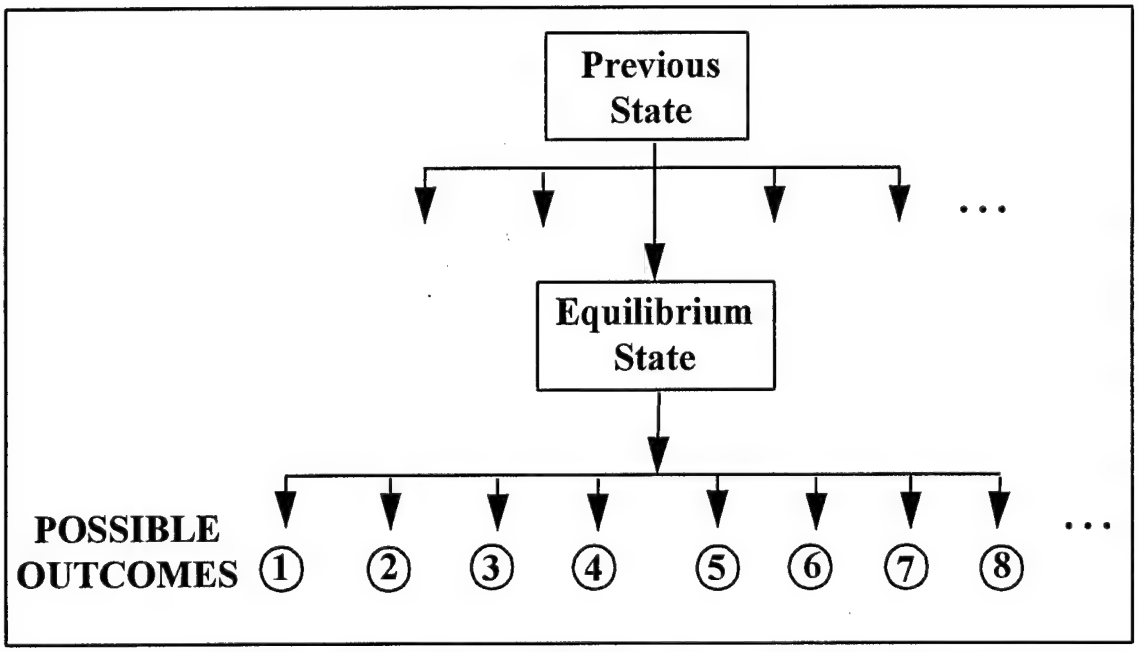

FIGURE 2: NOTIONAL MARKOV CHAIN

This does not eliminate the information chain from returning to a previous state via destructive techniques and feedback loops, but the quantity of information entropy must grow to a larger value on the second visit to that state. Death is not the opposite of birth, but the biological end state is the same as prior to birth with the increased entropy created during the life span of the organism that lived and interacted in the system.[67]

Each possible outcome would have a probability of occurrence dependent on the orientation data base and new information made available. These probabilities are represented by a probability distribution function. By altering the orientation data base or stimulating the orientation data base with an appropriate new information packet, the orientation distribution function can be modified. This can and will increase or decrease the probability of occurrence for the some of the possible outcomes of the Markov chain. Outcomes or variants could be reduced to near zero probability, thereby changing the likely choice as an attractor state for the decision maker as shown in Figure 3.

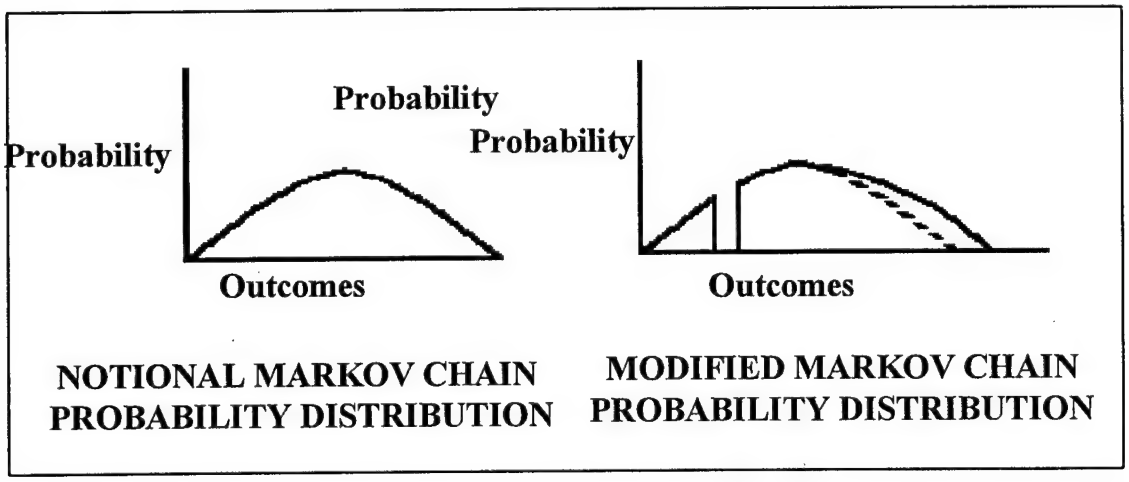

Figure 3: PROBABILITY DISTRIBUTION

Known paths could be forced within the Markov chain by appropriate construction of the orientation data base, thereby resulting in particular conditions occurring that are the effectively known paths or the failure states of the information system. Failure states are endpoints of the Markov chain paths where choices to leave the state do not exist. These endpoints are mathematically called "absorbing" Markov chains and may or may not exist for a particular system of choices. An advantage to being able to predict these end-states and failure states is that the

information engineer is better able to construct information packets that are precise and reduce the probability of unintended collateral damage.

Information Packet Parameters

A critical component to the analysis of the information system obviously is documentation of the existing orientation data base and all of its component information packets. Several authors have described portions of what may be the first insights to the parameters. A semantic space with parameter dimensions and a meaning vector from the origin attempts a mathematical structure.[68] Another aspect is that of image schema's which link perception and reason to the meaning intended and are distinguishable as separate entities from words.[69] Observations in an "acoustic space" where "everything or event creates its own space, and time" serve to support the information energy packaging theory proposed here.[70] However none of these explain the total phenomena of information packet parameters. This task may seem impossible at this writing, however many scientific things were once viewed as impossible in the past, such as mapping the human gene. Technology may eventually provide the tools and capability. Perhaps the answer lies in a third universal constant. The first two, relativity producing the speed of light and quantum theory Planck's constant, link energy, mass, particle momentum and wavelength. Perhaps a third exists linking the energy and biological aspects of information packets and "the scale of nature" will be discovered.[71] Absent such discoveries, absolute precision eludes the information engineer. Even so, it appears that a model can be constructed and employed with more precise outcomes than are possible in the absence of a model. Said another way, if a theory and system works, it offers greater promise of effectiveness than existed without one.

Measuring the Adversary System

As we measure the information packets within a particular system we are creating new information as we go. The measurement process is in effect chasing the answer of documentation of the information packets by its own creation of more information. Heisenberg's uncertainty principle appropriately describes these phenomena where the state of the system is altered by measuring the status of the system. One cannot obtain measurement of an information system without effecting the energy of the system.[72] To obtain a true measure the state of a system one must be outside the system and of the correct scale. So we cannot hope to fully document the status of the information system without altering the status as we go. The resulting conclusion is that the Markov chain process must be stochastic for the whole of all information packets, but can be treated as chaotic in a statistical sense for a subsystem that may be of interest. "In quantum mechanics, the whole past of an individual system does not determine the future of that system in any absolute way but merely the distribution of possible futures of the system."[73] For example, and again using the single toss of a die, the next roll is independent of all previous rolls, but the distribution of possible outcomes for the toss is known by the distribution from the past tosses. For the information engineer or information warrior the subsystem of the adversary orientation may be analyzed identifying possible outcomes using past results that formed or contributed to the formulation of the orientation. For example, historical enmities between two groups periodically cause the groups to fight. It is reasonable to infer from this historical data that the groups are oriented in such a way as to be hostile to one another. An observer inside of one of the groups, however, might be oriented in such a way as to believe that only one of the groups, the opposing group, is hostile.

Perhaps reasonable results can be obtained if the subsystem is not significantly derived from and therefore dependent on outside information packets. If the adversary orientation subsystem has a significant base from outside information, then analysis of the information will cause alteration of our relative perception of the results as Heisenberg's uncertainty principle applies. For example, our perception of the adversary system and definition of his Markov distribution function would be distorted by our own common and shared information packets with him. This is not to say we would not understand his process, predicting the outcomes using a distorted distribution function is the problem. Our perception of the enemy information orientation is relative to the position from whence it is viewed. If we view the adversary's orientation from outside the adversary subsystem with no interdependence between the adversary orientation system and our own, then we have a true view. Thus, the notion of an "honest broker" can be explained as an entity that possesses its own unique referents and is not dependent on information derived from the orientation of any of the groups on whose behalf brokering occurs. If, however, we view the adversary's orientation with dependencies to our information packet system, the view is distorted by the dependencies.

A complex but mathematically correct illustration would be where we interpret event X (a diplomat caught engaging in espionage) to mean outcome Y (declaration of a diplomat to be *persona non* grata) will occur, but because of interdependency condition A (our and the adversary's belief or orientation that all diplomats are spies, some are caught and some do not)outcome Z (a minor diplomatic protest) is selected by the adversary. Our prediction was based on the combination of X (a diplomat caught engaging in espionage) and A (our and the adversary's belief or orientation that all diplomats are spies, some get caught and some do not),

but when the measurement of A (our and the adversary's belief or orientation that all diplomats are spies, some get caught and some do not) in the orientation occurred sometime prior, it changed to B (the diplomat will be used as a double agent by the adversary), and the outcome Z (a minor diplomatic protest) was based on X (a diplomat caught engaging in espionage) and B (the diplomat will be used as a double agent by the adversary), instead of X (a diplomat caught engaging in espionage) and A (our and the adversary's belief or orientation that all diplomats are spies, some get caught and some do not).

Lastly, since the total amount of information entropy is growing and irreversible, the ability to gain a clear perception is decreasing as more and more interdependencies are created. This forecasts more randomness and chaos with increasing entropy for the total information system and a decreasingly clear perception of what the implications are. The effect is that the ability to document the Markov chains accurately decreases as the entropy increases.

System Stability

As new information packets are formed the reactions to them cause a new equilibrium state to be generated based on the Markov chain. The dynamic reaction to the new perturbation could be significant. Again, using the analogy of thermodynamics, if a large increase in entropy occurs in a short period of time, a dynamic reaction will occur. If the system is stable, then the reaction is damped and a new equilibrium state is reached. If the system is driven dynamically unstable due to the large entropy increase, outcomes are catastrophic. If however, entropy is increased slowly and incrementally, then the dynamic reaction is controlled and the system reaches

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a new stable equilibrium state. For example, a financial bank failure occurring without warning makes a large increase of the system entropy and may cause a dynamic reaction by a "run" on deposits in the bank. If however, the bad news financial health of the bank is incrementally released in lesser quantities and having the effect of increasing the entropy slowly, the adverse dynamic reaction may not occur. For the warrior the application to the information system is to control the creation of information in the adversary to preserve stability, particularly if dynamic instability is predicted for the Markov chain. This simply translates to the fact that time is required to shape the desired orientation of the adversary or risk of unstable dynamic reactions. The statistical chaotic and dynamic stability analyses correlate well to empirical data based on orientation that suggest "conditioning involves long time efforts and are highly non linear."[74].

In summary, the physics and mathematical analysis of the information system give us a statistic to describe and predict the process: that of Markov chains that are chaotic. Assessing the entropy of the adversary information system will form the initial probability distribution. Additionally, the orientation of a target that has dependent information packets formed from the same information that we form our own will result in uncertainty and a less accurate probability distribution of possible outcomes. Highly organized systems of little choice and low entropy, such as a totalitarian government may evidence consistent actions when compared to a changing and dynamic democracy. Thus it would appear that totalitarian systems are easier to predict and therefore more vulnerable to information engineering and control. The significance of this finding will become more clear later.

INFORMATION MODEL

The Engineering Model

The communication model described here is an expanded model of a simple transmitter and receiver system. This is a representation found in many electronics sources. This model is coupled with a modified decision process model using Boyd's OODA loop. The entire system model forms a complete path, allowing the information engineer to trace the flow of an information packet from creation to storage and decision making. The added features of the model include the new features that particularly apply to information engineering and information warfare.

The invention and creation of the model are understood best by the analogy and story told by Boyd of how a snowmobile was or might have been invented.[75] For the information engineering case the assembly process involves the chemical and electrical brain, the advertising and marketing group techniques of mass with more precise aims, and finally the application of physics and mathematics to the concept of information bits. It spans the information problems previously described, including technical transmission, semantic meaning, and the effectiveness of resulting actions. The output of this assembly is the information engineering model, concentrating on and applied to the area of information warfare.

The information engineering model block diagram in Figure 4 is intended to explain, predict, and ultimately be used to control the flow of information packets. Each block describes an important step in the process. Each step serves a specific purpose. Each step is thus a portal

through which the engineer or warrior can enter and influence the process. A gross description of the model indicates that two inputs are available to enter the model, one feedback loop exists within the model, and one output is produced by the model. There also is one summing point where information packets are colliding and combining. Also, the current state of the entire process is not necessarily in equilibrium until the propagation time has elapsed for the flow from input to output. Lastly, the feedback loop provides for continued iterations as feedback occurs. Therefore a final equilibrium state of the Markov chain may not occur depending on stability of the system.

The combination of the transmitter and receiver model with Boyd's OODA loop may be criticized as an improper combination.[76] It is not, and for three reasons. First Boyd's loop represents a simplified diagram of very complex "processes." A process infers multiple events and components. The model offered merely elaborates on some of those key activities and components. Second, "observations," although affected by "orientation" in Boyd's model, may in reality be so conditioned by orientation as to be controlled by orientation. Some commentators, Jeffrey R. Cooper to name one, place "orientation" as the preliminary component of the model. Third, if we accept that the complex of the real world causes Boyd's model to be necessarily reductive, we can both restore the complexity and preserve the simplicity by altering the model. In this case, we do that by viewing the information packet as a "thought" and attempting to understand the transmission of that thought and the resulting decision making. What Boyd actually intended is unclear. The OODA loop, has never been published as a loop, although a drawing in Boyd's own hand has been provided. It is known, however, that the OODA loop was originally called the SODA loop (with the "S" standing for "sensing"), but Boyd worried that this

would trivialize his model. Rather than trivialize it, the model offered intends to give it greater validity and utility by depicting the precursors to "observation" and by illustrating that both direct observations and individual or group orientation can affect "decision making," and hence "action." A discussion of each stage, process, or block within the information engineering model follows.

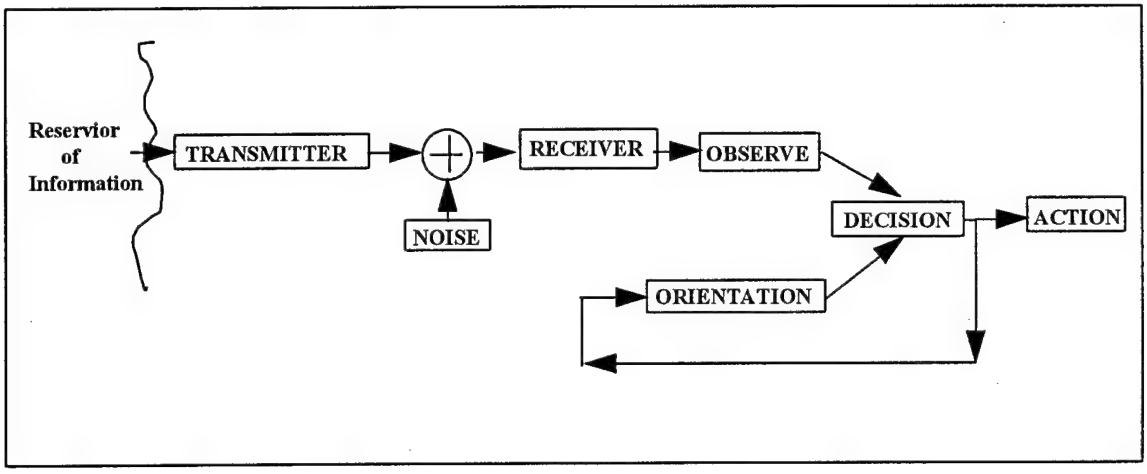


FIGURE 4: INFORMATION PROCESSING ENGINEERING MODEL

Network Input

The input from the network refers to the source of the information packet, originating from somewhere in the available body of information. The available body of information may be thought of as a "reservoir" in a grand sense. The body of information, the reservoir, is affected by entropy and is the source or connection depicted as the network connection. The information packet is transmitted through this connection. At this point the information is a thought, an idea, or a notion related to knowledge, belief, or awareness. To enter the reservoir it must be a formulated thought, an idea, or a notion related to knowledge, belief, or awareness. Said another way, a reservoir of information is necessarily a repository of already extant information. Of particular importance is awareness that the network is only an access point to the body of

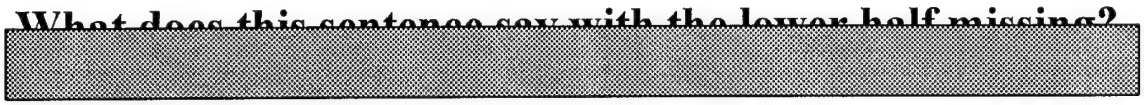
information and is not a point of forced transmission. In other words, not all the information in the reservoir will be transmitted. The significance of this point is that access and inputs to processes described in the engineering model are limited for those that have the will and means to control them.

Transmitter

The transmitter serves to convey the information packet via some communication medium or channel to initiate the next stage of the process. The transmitter encodes, and hence transforms, the information packet into signs, symbols, language, images or pictures, or metaphors. This process of transformation also may be viewed as the process of corrupting the information. As Shannon notes, encoding may result in some loss of redundancy in the information. That is, some information may be lost and some must be added. Encoding results in both connotative (referring to the meaning of images) and denotative (referring to the dictionary or semantic meaning) transformation that is represented in the information packet.[77] Recall that information is comprised into packets, similar to waves or particles, and can be transmitted to or through any of the human senses.

The minimum number of bits required to represent a particular information packet is finite. However, the actual representation typically provides for redundancy. The result is an ability to transmit the information packet with some transmission losses and still convey the information offsetting the effects of the noise. In digital communications the standard practice is to code and transmit additional bits for the purpose of error correction at the receiver doing the decoding.

The English language, for example, compensates for this potential loss and is estimated to encode with a fifty percent redundancy.[78] For example, can you read the next sentence?



Although the message has been corrupted through blocking or masking, sufficient character fragments, knowledge of syntax, and visualization all allow the message to be decoded by human semiotics. As discussed previously, the component parameters of an information packet are not fully known at this time. To fully understand the encoding process and make it efficient, these parameters must be documented. Even without this understanding, it is still possible to monitor system performance and predict outcomes. Without the parameter knowledge one looses the ability to create precision information packets. This is, of course, a significant deficiency, but not so significant as to prevent engineering.

Noise

The noise block is an important one. This step in the process represents the unintended addition of "information noise" to the communication channel. The noise could come in the classic form of simple background activity in the communication channel. For the information packet model described here one simple example would be two people talking to another at the same time about different subjects. A more sophisticated example would be two articles with differing views about a given subject. A final example to emphasize other forms of encoding would be attempting to savor the taste of a food that has been spiced with excessive pepper. In

this case the information packet of a desirable taste could be lost due to the noise of pepper. It is by effective utilization of noise that the information engineer can help the information warrior. It is within this input or access point that truth, spin, advertising, misinformation and deception enter the system. It is the single point in the model that information packets are forced into the system. Lastly, the noise input is not singular, multiple noise inputs are possible.

Summing Block

The summing point for the output of the transmitter and the noise block may be thought of as the information packet battlespace. Here thoughts are competing with each other and are essentially additive as an input to the receiver. Whatever constructive or destructive interference effects exist affect both the semantic and effectiveness levels of the information packets. For the information engineer or warrior this is the point or place to shape the battlespace. The emphasis here is on shaping, for the battlespace itself is the decision block to be discussed later.

Receiver

The receiver is the collection of the information packet from the communication channel. Just as the transmitter corresponds to one or more of the human senses, the collection is done by sensors that are the known five human senses of vision, hearing, touch, smell, and taste. These senses can be saturated with information packets and therefore flooded. There is no damage derived from flooding a sensor, however a saturated sensor may impede a particular information

packet from timely reception. "Timely" in this case means in sufficient time for propagation, represented as one decision or choice in the Markov chain. A tactical application tool would be for the warrior to saturate a particular sensor while using another sensor receiver for propagation of the desired information packet. For example, flooding the television airwaves with multiple channels of entertainment to increase the choices of programming, also has the effect of diminishing the effectiveness of news channels to communicate with a large audience.

Observe

Observation is the next function. Here the information packet data moves from the receiver and is processed to decode the packet into the fundamental parameters that it represents. At first glance the observe block may seem to perform the same function at the receiver. They are, however, distinctively different. It is in the observe block where patterns are recognized and the information packet takes on meaning *independent* from the symbols or the encoding form that was used originally. An example of receiving data *without* observation occurring would be hearing a message but not listening, or reading a body of text but not comprehending the passage. Therefore, in observation a data reduction occurs to select a portion of the total information received that matches patterns that are understood. For example, one could "receive" an audio information packet in the syntax of foreign language in which one is not fluent. Since the foreign language information packet does not match a known pattern in the observation process, it can not be decoded and the information packet or message is lost. In this example the message was "received" but not "observed." This observation block in the model is critical for the warrior to understand. The target gives off indicators of receiving, but the indications of *observation* are

much more subtle and difficult to detect. The best example of actually receiving a message without observation may be illustrated by the North Vietnamese leadership during the Vietnam war with the United States. President Johnson was using selective bombing sorties to communicate with North Vietnamese leadership. The information packets of bombs were certainly "received" by the Vietnamese based on their reaction, but clearly they did not "observe" the intended message that President Johnson was attempting to send. The conclusion of this short discussion is that detection of observation, pattern recognition of the decoded information packet, is critical to the information engineer and warrior.

Orientation

The orientation block contains the entire set of old data that exists within the target. The beliefs of what is true and untrue are contained in this memory. The sum total of information packets that have ever been processed in the system are what make up the orientation block. This is different from the total reservoir of information described earlier. Recall that the reservoir is not accessible in its entirety. Even so, a well-informed individual has a large orientation base with respect to the catalogue of information on the given subject. Clearly however, the orientation data base is still only a subset of the network reservoir. This block of orientation data serves as a powerful influence that grows relative to the observed data with each addition to the orientation memory. The old cliché you can't teach an old dog new tricks has some relevance, but not to the point of that it is impossible to accomplish. As time passes and the orientation catalogue or directory grows in size, it becomes more and more difficult to change it dramatically from its

current state. For the engineer or warrior this means that precise weapon efficiency is demanded in the information battlespace to overcome adverse orientation data bases.

Decision

The battlespace where thoughts collide is the decision block or process. Here the output of the observation block is compared to the orientation memory and a new information packet is created that results in decision and choices being made through the Markov chain. I specifically do not use another summing block for this portion of the model for several reasons. First, the orientation data base normally has a larger weight or importance when compared to the observed data. That is, and as Boyd and others recognize, orientation conditions observation. Secondly, the orientation data base may be void on the information subject being processed and therefore the observed data may be the singular input to the decision block. For example, if the observation was made or acquired that one's best friend was now one's enemy, the orientation data base would weigh larger, thereby preserving the belief that the assertion of hatred was false. If however, the observation was made or acquired that a total stranger hated another in the absence of a previous orientation on the subject, the weighting from the observation is larger. Finally, the observed information packets and the orientation information packets are internal and imbedded, or become "soft-wired" in the target, and, therefore, are distinctly different from the external summation of noise and transmitter information packets.

The decision block directly affects the target where the summation of noise and transmitter information could also be received by other targets or non-targets. The external

summation could result in collateral damage or secondary effects that were unintended. The internal decision block is statistically chaotic in nature and conforms to the irreversible Markov chain process. This outcome of the battle is governed by the probability distribution function of possible outcomes at the time of the decision. To influence outcomes and win the battle the selected decision would typically need a higher probability of occurrence than others attracting it as a choice. Sending information packets through the system and causing a desired outcome from the observation would be an operational application of information warfare. Winning the battle using the orientation block would be strategic in nature since the system has been deeply penetrated with a hostile (to us) or desirable (to the adversary) orientation established prior to conflict. The only *external* access to the orientation block is through the feedback loop.

Feedback

After a decision is made and a new information packet is created, the information is fed back to the orientation block for the purpose of updating the memory and data base. This action, of course, affects the future decisions since the orientation is modified and continues to evolve. This is equivalent to "learning" by the decision maker. To strategically impact the information battlespace the orientation of the target must be known and influenced. Since the access is only through the feedback loop, the setup and influence takes time and requires that many information packets be processed in an iterative fashion. If, after one cycle of processing, the orientation block is updated and the observe signal is still present, then a second processing cycle will occur forcing another step in the Markov chain. Once again an old adage might be true; you tell

someone something long enough eventually they will believe it. Additionally reinforcement and sustainment of the desired orientation are needed since it can be eroded over time.

Action

The final block in the model is labeled "action." The new information packet created by the decision block may or may not result in actual activity. If action is taken, the output is delivered to the entropy information reservoir for others to possibly access. If, however, no external action is taken, the new information packet resides only in the orientation memory of the target. In effect a secret is created about the belief on a given subject. This is critical since the most accurate external visibility of the target is through its behavior or actions and not through the orientation block. A masking of orientation can therefore occur, and decisions influenced as a result, but without external predictive ability.

In closing, the model serves as a tool to explain, predict, and control the flow of information packets and their processing. The information warrior has access to the system through a single input to influence the probability distribution of possible outcomes of the Markov chain within the decision block. If the information warrior is capable of designing information packets that have predictable results within the model, then they will be the weapons of the war, the information bullets. Without that capability then current doctrine dictates that information denial or severing flow prior to the receiver be employed. This is evidenced by our destruction of command and control infrastructure of our past adversaries. With the "information bullets" that are fully capable of precision attack, then a new doctrine is both possible and highly desirable.

One must ensure connection of the target receiver for the information packets to be observed and desired outcomes can be influenced.

INFORMATION WARFARE

The Application

The application of the information packet model to the development of non-lethal tools for warfare is the next step in this process. Theories without immediate practical application may be less valuable than those we can apply now. Relationships must be developed between current warfare weapons, the new tools existing, and tools yet to be discovered in the arena of information warfare. Thus far I have identified the strategic, operational, and tactical relationships of the engineering model, and pointed out a few characteristics of the model that were of obvious value from an engineer's or warrior's viewpoint. A general category of weapons has been coined as "information bullets" which are information packets that have been designed for precision effects. In general the class of weapons to be covered here are non-lethal in the sense they do not cause death as a first order effect. Certainly the secondary effects could be lethal and indeed massive in scope.

In information warfare the enemy or adversary could include the adversary's society and not just the military force that an adversary possesses. Indeed, Clausewitz recognized that a conflict could be resolved by attacking one of the three elements of the adversary trinity; the people, the state, or the military. In this case the people are the target. Perhaps the best prophet of the information war is Sun Tzu who has been quoted many times about the ability to win without the use of force. The decision of the adversary to not fight, but succumb to your will displays the greatest of power and skill as a warrior. I have only one addition to these strategic

beliefs. The control and predictive aspects of the enemy that the future information warfare holds reside in using engineering techniques to fire precision information bullets.

A common belief is that information wealth has diffused power to the individual's level. I would agree from the aspect that access to information has made individuals wealthy. Individuals in the past that were information wealthy and had power over the masses that did not have the information. It is from these concepts that current doctrine evolves; that is, to cut the enemy tie to his sources of information will reduce his power. What I conclude is that access is equivalent to the military term of interdiction and that the current doctrine is one based on interdiction. Interdiction is defined as the delay, disruption, and destruction of the enemy's potential to bear force.[79] Another doctrine, that of control, superiority, or dominance of the battlespace appears to be possible and more effective than the interdiction methods. Control offers the significant advantage of predicting and influencing outcomes using information bullets.

As described earlier, information bullets can be created for the purpose of constructive or destructive effects on the existing information. Therefore, lies can become truths, reality can become distorted, and manipulation is the norm. Keeping track of the unaltered information will be a new task for both the engineer and the warrior, since the frame of reference will be from within the system and therefore subject to victimization itself. Recently published Department of Defense policy issued by the Secretary of Defense, for example, states "the alteration of official defense imagery by persons acting for or on behalf of the Department of Defense is prohibited."[80]

So what is an information bullet and do they already exist? I believe they already exist. For example, modifying or altering a resume for the purpose of a job interview is a simple and apparently common practice. Using the power of the media to destroy the credibility of an

adversary political candidate is already practical. The actor Tom Hanks as the character Forrest Gump was pixelated into the video of famous events of the 1960's and 1970's. In twenty years or more will the future generations recognize the false truths? History already has a tendency to be rewritten with time and slanted in the favorable direction desired by the writer and the perspective readers. Now with information bullets the process can be accelerated and reality altered undetectably and in near real time. However, these elementary examples offered here lack an important characteristic of the information bullet. The precision of the attacks are not accurate enough to hide the truth or reality completely to all on the network. The information bullets of today do not possess the precision to be fired without detection. This is not simply a matter of telling falsehoods and getting away with it. The information bullet is a precisely matched information packet that causes the decision maker to select a path in the Markov chain that is favorable to the engineer crafting the bullet or the warrior firing it. A better example might be when an innocent person is convicted for a crime via the prosecution's information bullets. The jurors believe beyond a reasonable doubt in the guilt. They selected the "guilty path" of their Markov chain due to the information packets presented to them in the trial. The area of jury selection has become a science in today's courtroom where the ability to determine orientation of potential jurors from *voir dire* is the science. Based on the orientation the information bullets can be precisely constructed to trigger the observations and influence the decisions of the jurors. So information bullets today are employed in an imprecise and barrage fashion, even though the science of precision is improving.

Even so, the following tenets on information warfare can be derived from the analysis here and the model.

- The strategic target of information warfare is the adversary orientation.
- The operational targets are observations. and the tactical targets are the transmission and receiver mediums.
- Today's commanders and military forces are not prepared to wage operational and strategic information warfare.
- State versus nation state information warfare is a national activity in both its offensive and defensive aspects.
- The effects of command and control warfare are tactical in nature and have little effect on the adversary society or orientation.
- For control and prediction of the adversary it is better to keep the information warfare communication link established to the adversary.
- Military battle jargon does not characterize informational warfare as battles, nor does a hostile physical environment have to exist for information warfare to exist between two adversaries.
- Propaganda resulting from non precision information bullets alerts the adversary to engagement.
- Transitory information packets serve as better bullets providing flexibility for the battlespace.
- Taste, touch, and smell are under-exploited as communication mediums and identify a broader field of atypical sensor use in information warfare.
- Monocultures with known and verifiable orientation may be more vulnerable to information warfare than multi-cultures with a large information pool to base their orientation.
- Finally, predictable results from precision information attacks are not possible without two critical accomplishments; precise modeling of the adversary Markov chain, and generalized information bullet parameter knowledge.

As a final thought, one dreams with visions of the future that are believed impossible, only later to be filled in by the technology and information of the possible, or a beautiful theory crushed by the horrid facts of reality. "Between physics and philosophy there lies a debatable territory... called scientific epistemology... the nature of knowledge."[81]

END NOTES

[1] *Air Force Issues Book 1994* (Department of the Air Force, Air Force issues team, SAF/LLX, Pentagon, Washington, DC), p. 30.

[2] Richard Szafranski, "When Waves Collide: Conflict in the Next Century", p. 3, projects that without technology and information weapons are less useful and generally inferior to information based weapons.

[3] "A National Security Strategy of Engagement and Enlargement," July 1994, p. 14, describes the broadening scope of intelligence to include economic and political intelligence with military intelligence requirements increasing the demands for information to sustain the national power.

[4] Samuel B. Griffith, *Sun Tzu, The Art of War*, (New York: Oxford University Press, 1963), p. 77, translates "to subdue the enemy without fighting is the acme of skill."

[5] Wyatt C. Cook "Information Warfare: A New Dimension in the Application of Air and Space Power," AWC 94 class paper proposes doctrine for information warfare.

[6] Joint Pub 3-05, "Doctrine for Joint Special Operations," 28 October 92, p. II-2 through p. II-11 describes the missions of special operations in detail. Their description is an extension or evolution of previous doctrine and missions and does not offer insight into the revolutionary implication of information warfare.

[7] Richard Szafranski, "When Waves Collide: Conflict in the Next Century," p. 3, uses the words "even useless" for other forms of weapons if one does not first possess "the truth and the knowledge of authentic reality."

[8] Draft Joint Pub 3-13, "Joint Command and Control Warfare (C2W) Operations," 15 Jan 1994, chapter III defines and outlines the five areas of C2W.

[9] John R. Boyd, "A Disclosure on Winning and Losing," August 1987, p. 5, describes his OODA loop process and contends that to win one must get inside the adversaries OODA loop or time cycle. In others words operate faster than the enemy out processing the information in the decision cycle. A detail discussion on this subject was conducted via telephone interview on 9 February 1995.

[10] The author wishes to convey his appreciation and thanks to Mr. Howard Dale for his support and assistance in the construction of the graphics within this paper.

[11] N. Wiener and J.P. Schade, "Introduction to Neurocybernetics", *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 1, established a definition early in the history.

[12] Jiri Zeman, "Information and the Brain", *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 71, discusses how memory writing is not individual unique based on a gene pool and therefore the process should be the same for all humans.

[13] Norbert Wiener, *The Human Use of Human Beings* (Boston: Houghton Mifflin Company, 1950), p. 15, as a professor of mathematics at the Massachusetts Institute of Technology

relates the formulation of new information by the analogy to the processing of a computer as it proceeds through a set of data.

[14] Margaret O. Hyde, *Brainwashing and other forms of Mind Control* (New York: McGraw-Hill, 1977), p. 8, documents a short history of the early beliefs about how signals are transmitted within the brain.

[15] Margaret O. Hyde, *Brainwashing and other forms of Mind Control* (New York: Mcgraw-Hill, 1977), p.15, estimates the quantity to be "at least 13,000 million."

[16] George Lakoff, *Women Fire and Dangerous Things* (Chicago: The University of Chicago Press, 1987), p. 370, concludes that thought is not just symbology, reason is not abstract, and the mind records data in its own way, not mirror images of reality.

[17] Norbert Wiener, *The Human Use of Human Beings* (Boston: Houghton Mifflin Company, 1950), pp. 5-6, outlines the fundamentals of Fourier analysis. Other sources for a more in depth explanation of Fourier series would be virtually any college calculus textbook. The most often application field for these and other extensions to the mathematical methods is digital signal processing analysis.

[18] Jiri Zeman, "Information and the Brain", *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 74, discusses harmonic analysis of semantic information asserting that information waves can be analyzed like any other wave.

[19] Jiri Zeman, "Information and the Brain", *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 75.

[20] Jiri Zeman, "Information and the Brain", *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 76.

[21] N. Wiener and J.P. Schade, "Introduction to Neurocybernetics", *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 2, accurately concludes that statistical estimation methods are the only mathematics that can work for the case of incomplete system documentation. Additionally, he points out that empirical data points to the conclusion that the system is non linear since inputs added or multiplied by a constant do not result in added or multiplied outputs.

[22] Peter Lang, Emotion Center Director, University of Florida, was interviewed on the results of his recent studies and broadcast 1 Feb 95 WSFA television channel 12 news Montgomery, AL.

[23] Marshall and Eric McLuhan, *Laws of Media* (Toronto: University of Toronto Press, 1988), p. 41, cites the existence of information in a vacuum compelling a non medium solution to the transmission of information. The only known analogy is electromagnetics.

[24] Margaret O. Hyde, *Brainwashing and other forms of Mind Control* (New York: Mcgraw-Hill, 1977), p. 12 describes the filtering process where some information packets are screened out an do not reach the awareness level of the conscious brain.

[25] Richard R. Bootzin, *Behavior Modification and Therapy* (Cambridge: Winthrop Publishers Inc., 1975), p. 1, offers a basic definition of behavior modification as the "attempt to apply

learning and other experimentally derived psychological principles to problem behavior." He also discusses the ethics of behavior modification in chapter 6.

[26] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p. 199, describes the loss of verifiable reality as delusion. While in that state the subject lapses into a primitive state of awareness and therefore would be limited in the ability to function as a credible adversary. The author continues with the concept of mass delusion as it applies to groups of people.

[27] Diane Chotikul, "The Soviet Theory of Reflexive Control in Historical and Psychocultural Perspective: A Preliminary Study", Naval Postgraduate School, Monterey, California, July 1986, p. 83.

[28] Richard Szafranski, "Neocortical Warfare: The Acme of Skill?" Military Review, Vol. LXXIV, No 11 (November 94), p. 41, invents the term neocortical and the defines relationship to warfare.

[29] Ravi Batra, *The Great Depression of 1990* (New York: Simon and Schuster, 1987), pp. 29-58, explains and summarizes P. R. Sarkar's social cycle theory of four social classes and their evolution and struggle against each other in "ages."

[30] Alvin and Heidi Toffler, *War and Antiwar* (Boston: Little, Brown and Company, 1993), pp. 57-80, explains the three waves of societies and relate the wealth production of each society to the way the society wages war.

[31] Samuel P. Huntington, "The Clash of Civilizations?" Foreign Affairs, Summer 1993, p. 23, puts forth his culture conflict theory based on religion beliefs independent of nation states and governments. See also responses to Huntington's article in Foreign Affairs, September/October 1993.

[32] Diane Chotikul, "The Soviet Theory of Reflexive Control in Historical and Psychocultural Perspective: A Preliminary Study", Naval Postgraduate School, Monterey, California, July 1986, p. 45, elaborates this as "purposeful manipulation and management of perceptions."

[33] Stuart Ewen, *Captains of Consciousness* (New York: McGraw-Hill Book Company, 1976), p. 83, indicates that a higher order exist, that of a group mind that has a being of its own.

[34] Norbert Wiener, *Cybernetics* (Cambridge: The M.I.T. Press, 1948), p. 158, indicates that the group information volume grows with time and that a temporary assembly of a group will have very little information.

[35] Werner J. Severin and James W. Tankard, Jr., *Communication Theories* (New York: Hastings House, 1979), p. 152, concludes that groups have impact on mass communication. The most important two are the synergistic strength of group and the prediction aspects from group association.

[36] Winifred Gallagher, *The Power of Place* (Toronto: Poseidon Press, 1993), p. 190, suggest a conformity of behavior based on the recognition of place. In this case the stored orientation will have a dominate role over observation of an unknown or new place.

[37] Winifred Gallagher, *The Power of Place* (Toronto: Poseidon Press, 1993), p. 12, discusses the history of this phenomena and the scientific proof now being finally documented.

[38] Ronald Berman, *Advertising and Social Change* (Beverly Hills: Sage Productions, 1981), p. 45, even suggests that the classical location of instruction changes from the classroom to the media for education about products or subjects.

[39] Ronald Berman, *Advertising and Social Change* (Beverly Hills: Sage Productions, 1981), p. 111.

[40] John Mann, *Changing Human Behavior* (New York: Charles Scribner's Sons, 1965), p. 111, describes the objectives of advertising but also goes further to explain that expectations of immediate influence on buying are not necessary if "a lasting impression" is made.

[41] John Mann, *Changing Human Behavior* (New York: Charles Scribner's Sons, 1965), p. 114, indicates that one should believe the medical evidence rather that survey opinions.

[42] Hugh Rank, *The Pitch* (Park Forest: The Counter-Propaganda Press, 1982), p. 16, describes the benefit promise as the "pitch" in advertising.

[43] John Mann, *Changing Human Behavior* (New York: Charles Scribner's Sons, 1965), p. 109, correctly identifies that printed material is permanent. This could offer continuous input to shape orientation but also reduces flexibility for the attacker to change the method or weapon of attack.

[44] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p. 105, discusses the ability of a dictator to mass brainwashing and control a population.

[45] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p. 144.

[46] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p. 145, proposes this scheme of playing to the emotions but not acknowledging the behavior changes as they occur.

[47] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p133.

[48] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p. 160.

[49] "Propaganda", *Comptom s Interactive Encyclopedia* (Comptom's NewMedia CD ROM, 1994)

[50] Hugh Rank, *The Pitch* (Park Forest: The Counter-Propaganda Press, 1982), p. 9.

[51] John Mann, *Changing Human Behavior* (New York: Charles Scribner's Sons, 1965), p. 122, goes further to explain however that results are obtained from propaganda, they are just unpredictable. He cites movies as an example of a propaganda medium.

[52] Joost A. M. Meerloo, *The Rape of the Mind* (Cleveland: The World Publishing Company, 1956), p. 102, points out that the apathy choice is more likely due to the numbing from bombardment of confusing and numerous information packets.

[53] Gregory L. Ulmer, *Heuretics* (Baltimore: The Johns Hopkins University Press, 1994), p. 29, offers a tone of warning but realizes that information labor or compilation and indexing is reduced and efficiency is gained that may allow for deeper insight when the information is analyzed.

[54] Oswald H. and Gladys D. Ganley, *To Inform or to Control* (Norwood, Ablex Publishing Corporation, 1989), p. 55, indicates this phenomena is economically driven but the resulting control is still present.

[55] "Information Theory," *Compton s Interactive Encyclopedia* (Compton's NewMedia, Inc., 1994)

[56] Norbert Wiener, *Cybernetics* (Cambridge: The M.I.T. Press, 1948), p. 38, based on the reversible property of time in physics but the irreversible property of time in evolution and biology.

[57] Claude E. Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana: The University of Illinois Press, 1949), p. 96.

[58] Claude E. Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana: The University of Illinois Press, 1949), pp. 97-98.

[59] Iiya Prigogine and Isabelle Stengers, *Order out of Chaos* (New York: Bantam Books, 1984), p. 117, points out that physicochemical transformations conserve energy but cannot be reversed.

[60] Norbert Wiener, *Cybernetics* (Cambridge: The M.I.T. Press, 1948), p. 11, details the concept of information entropy and disorder with respect to their relationship to living organisms.

[61] Iiya Prigogine and Isabelle Stengers, *Order out of Chaos* (New York: Bantam Books, 1984), p. 70, details the introduction in the 19th century the function called Hamiltonian (H) as the total energy of a system and described the system dynamics completely.

[62] Bing-Fei Wu, "Identification and Control of Chaotic Processes - The Kolmogorov-Sinai Entropy Approach," Doctor of Philosophy paper (Electrical Engineering) University of Southern California, pp. 7-10, calculates entropy for conservative [$h(T)=0$], chaotic [$1<h(T)<\infty$], and stochastic [$h(T)=\infty$] systems.

[63] Jeremy Rifkin, *Entropy* (New York: Viking Press, 1980), p. 35, also points out on p. 53 that "every living thing maintains its own order at the expense of creating greater disorder by using energy in the overall environment."

[64] Norbert Wiener, *The Human Use of Human Beings* (Boston: Houghton Mifflin Company, 1950), p. 7, relates this to the real world loss of meaning when books are translated and also the corruption of a telephone conversation due to line noise.

[65] Richard W. Hamming, *The Art of Probability* (Redwood City: Addison-Wesley Publishing Company, 1991), p. 253.

[66] Iiya Prigogine and Isabelle Stengers, *Order out of Chaos* (New York: Bantam Books, 1984), pp. 121-124, indicates that attractor states will be the state tended toward. It is important to note however, that all other outcomes are possible but have a lessor probability of being selected.

[67] Norbert Wiener, *Cybernetics* (Cambridge: The M.I.T. Press, 1948), p. 36.

[68] Werner J. Severin and James W. Tankard, Jr., *Communication Theories* (New York: Hastings House, 1979), p. 91, apply vector space mathematics to the problem of characterizing the parameters of semantic meaning.

[69] George Lakoff, *Women, Fire, and Dangerous Things* (Chicago: The University of Chicago Press, 1987), p. 440.

[70] Marshall and Eric McLuhan, *Laws of Media* (Toronto: University of Toronto Press, 1988), p. 53, outlines the creation of information and how it creates its own place in space and time. The relevance to Einstein's relativity theory may be important in the analysis of the parameters.

[71] Werner Heisenberg, *Physics and Philosophy* (New York: Harper and Brothers Publishers, 1958), p. 164, suggest that since systems need three fundamental units to complete a set of units that a third universal constant must exist to complete our set of units for the universe.

[72] Norbert Wiener, *Cybernetics* (Cambridge: The M.I.T. Press, 1948), p. 58, applies Heisenberg's uncertainty principle appropriately to the biological information system discussed here.

[73] Norbert Wiener, *Cybernetics* (Cambridge: The M.I.T. Press, 1948), p. 93.

[74] N. Wiener and J. P. Schade, "Introduction to Neurocybernetics," *Nerve, Brain, and Memory Models* (Amsterdam: Elsevier Publishing Company, 1963), p. 2.

[75] John Boyd, "A Discourse on Winning and Losing ," August 1987, describes the synthesis of conceptual parts of images to produce the invention of a snowmobile. Take the skis from a ski slope, the outboard motor of a motorboat, the handlebars from a bicycle, and the rubber treads from toy tractors or tanks and synthesize them into a snowmobile. Winners can synthesize, losers cannot.

[76] The critics would contend that the transmitter and receiver model explains the movement of an information packet where the OODA loop explains the analysis of the information packet. If an information packet is matter in the form of "organized" energy then both models deal with the same material.

[77] Werner J. Severin and James W. Tankard, Jr., *Communication Theories* (New York: Hastings House, Publishers), 1979), p. 89.

[78] Werner J. Severin and James W. Tankard, Jr., *Communication Theories* (New York: Hastings House, Publishers), 1979), p. 46.

[79] FM 100-5, "Operations," June 1993, pp. 2-18,2-19. Additional information can be found in Joint Pub 3-03 and AFM 1-1.

[80] "DOD Policy on Alteration of Official Photographic and Video Imagery," Secretary of Defense message 032030Z FEB 95.

[81] Authur Eddington, *The Philosophy of Physical Science* (Cambridge: University Press, 1949), p. 1, states that a significant part of all knowledge came about as a result of the physical sciences.

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